The State of Forest Health in New York
November 12, 1989

New York State Department of Environmental Conservation
Division of Lands and Forests

Robert H. Bathrick
State Forester

by Michael J. Birmingham

Forest Resource Management
50 Wolf Road
Albany, New York 12233 4253

TABLE OF CONTENTS

I. Introduction.....3
About this report
Forest decline definition
Forest decline symptoms
Forest decline history

II. Seven Major Tree Declines.....5
American chestnut
American beech
Ashes
Elms
Maples
Oaks
Red pine

III. Learning More About Forest Health Problems.....12
Air pollutions effects on forests
Cooperation with others
Eastern hemlock decline
Forest health reports
Gypsy moth larval disease
Larch declines
Spruce/fir declines
Sugar bush decline study
Sugar maple decline study
Urban Tree Inventories

IV. Plant Conservation.....21
American ginseng
Protected native plants
Rare plants influence land use decisions
US Fish and Wildlife Service funded plant studies

V. Future Forest Health Problems.....23
Aging
Pestilence
Management limitations
Loss of biological diversity

VI Conclusions.....25

Appendix A, Capital District and Catskill-Lower Hudson River.....26

Appendix B, Eastern, Western and Northern Adirondack Regions.....31

Appendix C, Lake Plain, Southwest, and South-Central Highlands.....32

Indices.....33
Regional Forestry Offices.....35
Regional Map.....36

INTRODUCTION

About this report

This report updates the last report dated September 28, 1988. Red pine is added to the list of trees declining statewide. The section on declines from unknown causes has been deleted. Species formerly listed as declining from unknown causes have been listed under the section "Learning More About Forest Health Problems" or, in the case of yellow birch, listed under Appendices B.

Forest declines occur in New York State. Their presence does not mean that forests will disappear. Forest acreage and size of trees in the state are increasing. Our forest acreage has increased nearly 8 million acres in the past century and growth exceeds harvest by a factor of two. US Forest Service scientists report that of ten major tree species in northeastern United States eight have increased radial growth rates between 1950 and 1980. The only two species declining in radial growth rates were red spruce and balsam fir. However, insects, diseases, and declines are changing the relative abundance of tree species and other plants. When a tree dies, others take its place. We should be aware of these problems and work to maintain biological diversity and forest health.

For additional information on regional forest health refer to the appendices in this report or write or telephone the appropriate DEC forestry office listed in the Regional Directory on page 35. Statewide information can be obtained by writing or telephoning Daniel Weller, Chief, Bureau of Forest Resource Management. His telephone number is 518-457-7370. His address is: New York State Department of Environmental Conservation, 50 Wolf Road, Albany, New York 12233-4253.

Forest Decline Definition

This report utilizes the term "decline" to describe unhealthy conditions of our forests and trees. By forests, we mean trees and other plants occuring in urban and rural areas.

Decline can result from insects, diseases, mites and roundworms (nematodes), droughts, temperature extremes, wind, flooding, chemical poisoning, air pollution, nutrient deficiencies, erosion, land clearing and unwise harvests or a combination of any or all of the above. The term "decline", as used in this report, will encompass the various known causes of observed declines, and will describe

the observed declines where the cause or causes are presently unknown or uncertain to the scientific community.

Forest decline symptoms and effects

Declining forests or trees have one or more symptoms: misshapen, sparse, missing, tufted or discolored foliage; no foliage or vegetative buds (dead); branch dieback; breakage or deformities of branches or trunk; bunching of branches (brooming) or uprooted; loss or shredding of bark.

Effects of forest declines on flora are: failure to reproduce, reduction in relative abundance, poor form, reduced growth rates, mortality and fewer species.

Forest Decline History

Forest declines are not new. Peter Kalm, a Swedish naturalist, wrote about forest declines in New York in 1750. In the book entitled Peter Kalm's Travels in America of 1750, he writes: "The woods ... have never been cut down, and they have always grown without hindrance. It might therefore be expected that there are trees of an uncommonly great age to be found in them. But it happens otherwise, and there are very few trees three hundred years old. Most of them are only two hundred years and this convinced me that trees have the same quality as animals, and die after they have arrived at a certain age. We find great forests here, but when the trees in them have stood a hundred and fifty or a hundred and eighty years, they are either rotting within, or losing their crowns." Peter Kalm described insect defoliation, rots, wind and other causes of forest declines. Tree declines were described as not of recent origin by the State Entomologist in his second annual report to the State Education Department in 1882. He described declines of red spruce in Rensselaer County in 1843. Reports of declines have continued since that date. Numerous pests of trees have been introduced to New York within the past 150 years. Many of these exotic pests lack natural controls and our native trees lack resistance to the introduced pests. Consequently, these pests spread rapidly and increase in numbers. The cumulative effects of introduced pests on trees is the single greatest factor in the decline of forest health in New York. Similarly, introduced tree species often have little resistance to native insects and diseases. We recognize pest problems in introduced trees caused by native pests.

Damage to trees from oxides of sulfur, fluorides, ethylene, oxides of nitrogen, ammonia, chlorine, hydrogen chloride, and particulates have been documented to damage or kill plants near their sources and this recognition in the case of oxides of sulfur and ethylene as destructive of plants has been known for more than 100 years. Ozone damage to

eastern white pine in the Adirondacks causes a disease known as chlorotic dwarf. More recently, scientists have shown that high levels of acid rain, toxic metals and photo oxidants are associated with forest declines, but their precise role in stressing or directly killing trees is not established.

SEVEN MAJOR STATEWIDE TREE DECLINES

Tree declines listed here meet the following criteria: declines are long term, statewide, change the relative abundance of tree species and cause significant economic, environmental or land management problems.

American chestnut

Chestnut blight, a fungus introduced to New York City in 1904, caused the most important tree decline in New York. Chestnut constituted 25 percent of the timber volume in New York State at the end of the 19th century. By 1930, the blight had killed nearly all mature chestnut trees to the ground level. No other tree disease has been as destructive. It continues to prevent chestnut trees from reaching its former size and abundance by causing cankers that girdle the tree.

Chestnut trees are produced from stump sprouts and nuts. The chestnut blight does not kill the chestnut tree below the root collar. When abundant light reaches the root collar, vegetative buds form and sprout. On many drier sites following logging, chestnuts sprout prolifically and grow for 10 to 15 years before being killed back to the ground by the blight. Chestnut trees often reach nut bearing age. Nuts collected from wild chestnut trees have produced seedlings in experiments conducted by DEC foresters at Lowville. Neither the parent chestnut tree nor its progeny from stump sprouts or nuts are resistant to the blight.

Non-lethal strains of chestnut blight exist. Infection by a non-lethal strain stops the formation of cankers and prevents girdling. In Europe, a non-lethal strain of the blight has spread naturally, protecting European chestnut. DEC foresters introduced to New York a non-lethal strain of the blight in 1985 and 1986. This work was not successful. In order for a non-lethal strain of the disease to become established and spread, it is necessary to match it with the lethal strain. Work by scientists at the Connecticut Agricultural Experiment Station stopped lethal cankers by inoculation with a non-lethal strain of the disease. However, the non-lethal strain does not spread adequately in the wild.

Blighted tree leaves wilt beyond cankers. Chlorotic leaves develop on shoots infected in early spring and die prematurely. Stem cankers are yellowish brown, orange-brown or reddish brown. They maybe sunken or slightly raised. Cankers move laterally 5 to 10 inches each year.

American beech

Beech bark disease, which first appeared in Nova Scotia in about 1920, is killing American beech throughout the State and particularly in western New York, where the disease has reached within the past few years. The disease has killed more mature trees in New York than any other cause, except for chestnut blight. Not all American beech are vulnerable to the disease. Mature beech remain in forests infected by beech nectria 25 years earlier. Beech continue to produce beechnuts. Beech also reproduce from root suckers, resulting in thickets of beech saplings.

For beech bark disease (nectria fungus) to enter the bark of beech, it must enter a wound usually caused by the beech scale, an insect introduced to Halifax, Nova Scotia in the late 1800's, or wounds caused by Xylococculus betulae (no common name) or cracks in the bark caused by drought. As the beech scale spread westward across New York State, beech bark disease increased in frequency and intensity. Beech scales cause the bark to turn white. X. betulae produce waxen, thread-like tubes, often tipped with a droplet of honeydew. The nectria fungi causes cankers that roughen the bark. Tiny red fruiting bodies of the nectria are visible inside the bark cracks by autumn. Two species of fungi cause beech bark disease in New York. The foliage of beech infected by nectria turns yellow and then brown.

Beech is an important tree species. It provides food for wildlife and its wood is used for fuel and lumber. Beech is one of three major tree species in old age northern hardwood forests. Its decline may have significant ecological effects on plant communities, such as subsequent decline of mature yellow birch, which is intolerant of site disturbances. Beech roots produce sprouts from nectria-killed trees add to the cost of forest management. They crowd out more desirable tree species and timber owners incur additional expense in destroying them.

Dead beech rot quickly. They should be harvested promptly to prevent significant economic losses from wood decay and staining.

A predacious beetle has destroyed large numbers of scale insects. The predacious beetles are a significant factor in beech recovery observed throughout the state.

Ashes

Ash yellows is another major cause of tree declines in New York. White and red ashes are susceptible. The disease is caused by a microplasma-like organism. Ash yellows may kill entire stands of ash or it may kill only some individuals. Some ash appear resistant to the disease. Ash yellows has occurred throughout New York State at epidemic levels since the early 1950's.

Symptoms of ash near death from the yellows disease are sparse, tufted foliage or rosettes at branch tips. Diseased tree foliage is yellowish, particularly on rosettes and brooms at the base of infected trees. A more advanced symptom is branch dieback. Near death, trees have foliage growing from the trunks and "witches'-brooms" or shoots at the base of the tree. Radial growth and twig elongation is reduced by one-half or more within one year of ash yellows infections.

The ash yellows pathogen is vectored by two insects: a leafhopper and the meadow spittlebug. It does not spread by ash seeds. Seeds of diseased trees are not viable. Leaving diseased ash trees in place does not contribute to the spread or intensification of ash yellows disease.

Merchantable diseased trees should be harvested, since they do not make significant radial growth and die within five years. Although standing ash does not rot quickly after death, the value of its wood for sawlogs deteriorates quickly because of attacks by ash borers and wood-staining fungi.

Ash reproduce at an early age. There is no risk of them becoming extirpated in any region of the state. Ash make up a significant component of New York's forests. One of the primary species colonizing open lands is ash. The rate of ash yellows infections is higher where ash densities are greatest. Ash yellows disease will decline as ashes are replaced by more shade tolerant species.

Elms

Another major cause of tree declines is introduced Dutch elm disease, a fungal disease which completed its westward spread in New York by the 1960's. The disease entered North America before 1930 on elm logs from Europe. The three native species of elms, (American, rock and slippery) are vulnerable to the disease, although many isolated and young elms survive to produce viable seeds ensuring their survival.

Elms surviving the first wave of the disease or growing from seed after the first wave of the disease are killed by a second wave of the disease. The second wave follows the buildup of elm bark beetles. Elm bark beetles, including an

introduced European species (the most important vector of the disease) carry the disease to elms. The European elm bark beetle was introduced to the United States on elm logs before 1900. The disease also spreads by root contact. This method of spread makes it impractical to protect elms along city streets by killing elm bark beetles.

Dying elm foliage wilts, turns yellow and curls. More advanced symptoms are leaf fall and death of affected branches. Tree death follows within one or two years of first foliage symptoms. Internal symptoms of the disease are browning of sapwood in streaks.

Elms can be protected from elm bark beetles that vector Dutch elm disease. Beetles are controlled with insecticides and destroying their breeding habitats. Pruning of diseased branches and injections with fungicides can prevent the spread of the fungus to the main stem and resultant death of the tree. Community-wide programs can reduce elm losses to less than one percent annually. Elm species and individuals within a species vary in resistance to the disease. Fungus strains are variable in their ability to cause disease. Cacodylic Acid kills elms quickly and make them unsuitable for elm bark beetle breeding habitats. The advantage of acid killed trees is that they do not have to be removed quickly to prevent beetle populations buildup in them and attacking nearby elms.

Elm yellows disease, which has been found in the Finger Lakes Region, causes similar foliage symptoms to Dutch Elm disease and also kills elms. This disease is more serious than Dutch elm disease in the Finger Lakes Region. Insecticide sprays kill leaf-infesting leafhoppers and spittlebugs that vector the disease.

Symptoms of the disease occur in mid to late summer. They are yellowing of leaves, drooping of leaf petioles, premature leaf drop and dead branches. Symptoms frequently occur uniformly throughout the crown. Elm yellows produces a characteristic odor of oil of wintergreen from American elm and of maple syrup from slippery elm leaves and bark of freshly killed trees. Brooming occurs at the base of elms following the second season of infection.

Elms will remain a part of our landscape. However, they will not return as majestic monarchs soon given the two virulent diseases and their lack of natural resistance. Species of elms that are resistant to Dutch elm disease are available. They are hybrids of American and Asiatic elms. The latter hybrids are resistant to Dutch elm disease and inferior in form to American elm.

Maples

Symptoms of maple sapstreak are dwarfing of foliage and crown dieback. On freshly cut, infected trees, maple wood is water-soaked gray or brown. Infected trees die within a few years. Their wood is devalued due to discoloration. To reduce economic losses from maple sapstreak, reduce wounding and remove diseased trees promptly to salvage wood. Poor taping practices and soil compaction by machinery and cattle are other causes of maple declines in sugar bushes. Declines are attributed to over maturity, defoliation, drought and acid rain. Soil compaction is a cause of maple declines in developed areas. The sugar maple borer is the most important cause of degradation of sugar maple wood.

Pear thrips, an introduced insect defoliator of maple, is of statewide distribution. First introduced to California from Europe in 1904, it was observed in the eastern United States in 1968. The pear thrips were first recognized as the cause of leaf tatter in maples in 1985 in New York. Previously, leaf tatter was attributed primarily to frost damage. Symptoms are leaf tatter, mottling, cupping, browning, yellowing, small size and premature fall.

Pear thrips populations collapsed in New York in 1989, except for an infestation west of Chautauqua Lake. A disease of adult thrips that overwinter in soil is the cause of the population collapse. Extensive soil surveys were conducted in central and northeastern New York to assess pear thrips population densities. These surveys revealed low to moderate populations.

It is impractical to protect forest trees from pear thrips. Thrips damage trees by reducing their energy levels through removing nutrients from the leaves and from releafing. Sugar maple with severe foliage damage have low to no reserve starch and often decline.

Maples severely damaged by thrips should not be thinned or tapped for maple syrup within a year of the damage. Thinning can remove maples that would have survived thrips' attacks and leave maples that would die from thrips' attacks. Not knowing which trees to remove leads to under stocking of the stand. Thinning stresses residual trees by increasing the amounts of sunlight reaching the soil and bark. Severe damage to bark can occur from overheating of bark. Tapping can be unproductive in maples that have depleted sugar levels. Tapping further stresses the trees. Thrips damage reduces sugar maple sap productivity, results in poor fall coloration and reduces growth. The ability of young maples damaged by thrips to compete with other tree species is reduced. Pear thrips are controlled naturally

following one season of severe foliage damage. Natural controls have prevented pear thrips from causing widespread tree mortality. Branch mortality following one season of pear thrips feeding can occur.

Large tar spot disease was first discovered in New York in 1983 near Utica. Its host is Norway maple. Between its discovery date and 1988, the disease was known only from the Utica. and Ilion area and a small area in Erie County. This year, DEC identified the disease on Norway maple in Scotia, Schenectady County and Fort Ann, Washington County.

There are two types of tar spot diseases in New York. Common tar spot disease infects red and silver maples. It causes a tar-like spot one quarter to one half inch in diameter. Spots are raised, have a leather-like grain and a weak yellow ring around the perimeter of the spot. Large tar spot does not infect red or silver maples. Spots are one inch in diameter, flatten, lack a leather-like grain and have a distinct yellow ring around their perimeter. Large tar spot disease causes heavily infected trees to loss their leaves in August.

Other causes of maple declines are salt injury and flooding. Deicing salts damage maple roots and prevent the uptake of water. Evidence of salt injury are premature leaf color change and fall. Tops dieback on severely damaged maples. Salt damaged maples are slow to heal wounds. Frequently, salt injured maples have a high degree of rots, which can lead to breakage of branches and trunks during storms. Red maple standing in excessively wet soil or soil that is annually flooded for a few weeks during the growing season develop yellow, undersized leaves and sparse crowns. Changes in water drainage caused by construction and beaver dams contribute to annual flooding and declines of red maple.

Oaks

Oak decline is a major forest health problem. Oak decline is increasing because of the accumulative effects of gypsy moth defoliation, which now occurs periodically throughout the State. Declines are heaviest in the southern half of New York, where oaks and gypsy moths are most plentiful. Defoliated oaks are attacked and killed by the two-lined chestnut borer and armillaria root rot. Drought, which is widespread in New York in 1988, also increases the rate of oak mortality. Gypsy moth made a dramatic comeback in 1989. 450,000 acres of forest land in the state was defoliated more than 30 percent by this insect. Heavy defoliation occurred in southeastern New York including about 1,000 acres in Ridge, Suffolk County. Elsewhere defoliation was

intense in northern Westchester and Putnam Counties with a much smaller infestation in southern Dutchess County.

On the west side of the Hudson River in southeastern New York, gypsy moths defoliated large forested tracts in Rockland, Ulster, Orange and Sullivan Counties. North of Albany, gypsy moth defoliation occurred extensively in Glens Falls, Lake George and Keevesville areas. Defoliation was also widespread in Alexandria Bay area of the St. Lawrence River.

Mortality rates of this larva were extremely high from a fungus disease. Normally diseases kill caterpillars in the second or third year of an epidemic. However, the fungus disease, not previously recorded in New York, killed larvae in the first year of the outbreak. The fungal disease was detected on Long Island, southeastern New York and as far north as Keeseville. It was not found in the western Adirondack Region, Catskills or central and western parts of the state.

Declining oaks have undersized and yellowish leaves. Severe decline symptoms are branch dieback, leafing on the trunk and death.

Oaks are becoming less common. When oaks die, forests regenerate to other species - most commonly red maple. Maples regenerate well in partial shade. Oaks require abundant sunlight to regenerate. Most extensive oak stands regenerated on sites formerly occupied by chestnut and on drier sites abandoned for agriculture. Today, unlike the past, forests are regenerating where only selected trees are harvested and very little sunlight reaches the forest floor.

Clear cutting increases oak reproduction. Controlling defoliators reduces oak mortality and thinning promotes rapid growth. Because of management, oaks will continue to make up an important component of our forests.

Red pine

Red pine is widely planted in New York for ornamental and reforestation purposes. About 200,000 acres of red pine plantations were started in New York by the Civilian Conservation Core in the 1930's. Many plantings are on lands acquired by the state that were formerly used for agriculture. Former agriculture soils were typically infertile, eroded, shallow, excessively wet or heavy. Red pine grows best on deep, well drained sandy soils.

By the late 1940's, red pine plantations in New York declined on wet sites. Red pine decline is now widespread. It occurs on heavy soils in thinned and not thinned stands by age 50. Red pine growth rates under the age of 35

increases followings thinning. Growth rates of not thinned and thinned 50 year old and older red pines on heavy soils are similar.

Evidence of decline in red pine is tufted foliage. Tufting occurs when shoot elongation is short and needles are bunched together. Severe cases of tufting result in sparse crowns and heavy understory plant growth due to the abundant sunlight reaching the forest floor. In advanced stages of decline, tops of trees dieback. Declining tree foliage turns yellow and then brown in southern tier pines. Northern tier pine foliage does not progress through the yellowing stage. This may be due to the lack of bark beetle attacks and blue stain fungi in northern tier pines that are declining. In the southern tier declining pines bark beetles and blue stain fungi abound. Blue stain fungi enter pines on rounded headed beetles. The blue stain hastens the tree's death.

In some 50 year old or older declining stands, mortality exceeds growth. Thinning will not improve the longevity of such stands. Since the stands are even aged and all trees have a short life expectancy, clear cutting is recommended. Declining red pine should be promptly harvested or the wood quality will decline quickly due to the activities of bark beetles and staining. Also declining red pine should be removed before it rots and poses increased risks to loggers. Dead red pine rots quickly.

Regeneration of red pine on cutover or agricultural lands is through plantings. Advanced reproduction of understory plants are more competitive than red pine seedlings. To avoid advanced reproduction, harvest declining red pine before advanced reproduction occurs. Reforest the site the spring following the logging. If the site is replanted the second spring following logging advanced reproduction occurs. A disadvantage in planting the spring following harvest is pales and monochamus weevil attacks. Weevils breed in pine slash and fresh stumps. Weevils are controlled through seedling dips of pesticides or delayed planting. If they are not controlled, they kill upwards of 60 percent of the seedlings.

A cause of seedling mortality is root drying. Seedlings should be placed in moist trenches and their roots covered with soil, if they are not planted within one day of arrival from the nursery.

LEARNING MORE ABOUT FOREST HEALTH

Air pollutions effects on forests

Acid deposition's effects on forest vegetation and soils in central Europe is not responsible for the majority of forest declines taking place in that region. High levels of

hydrogen ion, sulfate and nitrate inputs have in some areas changed soil chemistry. Short term, trees may have benefited from these soil changes. Long term, trees may be harmed due to soil nutrient deficiencies and metal toxicities.

In the United States, a positive correlation was found between red spruce and Fraser fir declines in the southern Appalachians of eastern North America and atmospheric pollution levels. No definitive cause and effect relationships between acidic deposition and decline have been established.

In Tennessee, it has been demonstrated that high levels of atmospheric deposition can lead to depletion of nutrients such as calcium in the soil. When air pollution is coupled with logging, nutrient losses increase.

Canadians believe that declines of maples in southeastern Canada result from nutrient deficiencies - a concern expressed by European scientists. Aluminum toxics are of concern in North America and Europe. In laboratories, aluminum toxicity causes reduced root and shoot elongation. But individual tree species vary in their susceptibility to aluminum toxicity. In forest soils, aluminum levels remain below the threshold of harming trees, except in localized areas.

Studies funded by the Empire State Electrical Energy Research Corporation and the New York State Energy Research and Development Authority show that nutrient deficiencies have not occurred in the Pack Forest or Huntington forests of the Adirondacks. Atmospheric inputs to the forest soils of this region have increased and have removed some base cations. There has been no demonstrative decrease in growth of red pine or Norway spruce unrelated to natural factors. However, adverse effects of air pollution may not have been detected due to the difficulties in separating natural and unnatural climatic effects on tree growth.

Cooperation with others

DEC is working with all the New England States and Pennsylvania and New Jersey on pear thrips and hemlock woolly adelgid survey techniques and biology of these insects; with the College of Environmental Science and Forestry on predicting saddle prominent impact on host trees; with Boyce Thompson Institute on fungal diseases of gypsy moth and saddled prominent; with the US Forest Service on dogwood anthracnose, spruce/fir and sugar maple declines, beech bark disease and scleroderris canker; with the New York Natural Heritage Program, Cornell Plantations and the State Museum on inventories of plants, recovery of federally listed endangered and threatened plant species; with the US

Fish and Wildlife Service to ensure continued federal funding of rare plant studies and enforcement of ginseng regulations and export of New York grown ginseng.

Major cooperative efforts with other states occur on an annual basis through attendance and participation at the Northeast Forest Pest Council Meeting, Northeastern Insect Workshop, Northeastern Forest Pathology Workshop, National Gypsy Moth Annual Review, New York Ginseng Association, and special meetings of sister states and Canadians on insects such as the pear thrips and hemlock woolly adelgid.

Eastern hemlock decline

All of Long Island, New York City and Westchester County are infested with hemlock woolly adelgid. In 1989, it was was discovered on Clarence Fahnestock Memorial State Park near the intersection of the Taconic Parkway and Route 301 in Putnam County. Its most northern occurrence is Bowdoin County Park in Dutchess County. On the west side of the Hudson River it occurs in the Town of Windsor, Orange County. It has not spread west of the Palisades Highway in New York. On the east side of the Hudson River it has spread northward and northeastward by wind and possibly birds, which the adelgid has been found on.

Adelgids kill hemlock by starvation. Adelgid crawlers settle at the bases of needle petioles and feed in densities of one or two crawlers per needle base. Only current year growth is fed upon. Crawlers are present from August to February and again between late March to late June. The presence of the black, crawler with waxy secretion around its sides is clearly visable with a ten power magnifying lens. When they are not present, egg sacs are visible from the undersides of twigs. Egg sacs resemble q-tips in size and appearance and contain about 50 orange eggs.

Hemlock mortality occurs in Rockland, Orange, Westchester and Putnam Counties. Mortality, except in Westchester County, occurs within three miles of the Hudson River. Symptoms of hemlock decline are twig mortality, thin or yellowish crowns and branch and whole tree mortality. Mortality follows hemlock borer (beetle) attacks, which girdle the tree. Woodpeckers eat borers. Evidence of woodpecker feeding are piles of wood chips at the base of hemlocks, elongated feeding holes of up to a couple of inches wide and four inches deep in the trunks of hemlock and the sound of woodpeckers pecking. Woodpeckers do not prevent hemlock borers from girdling hemlocks. Hemlocks survive more than one year following hemlock woolly adelgid infestations. Some infested hemlocks survive two years. As the hemlock declines, it produces very short new growth. The short new growth has very few feeding sites for

the adelgids. As the number of feeding sites decline, the number of adelgids decline. Declining adelgid numbers may help prolong the life of the hemlock.

Prized ornamental hemlocks can be saved by spraying them with an insecticidal soap or horticultural oil, which kills the adelgid in any life stage by suffocation. Success in the adelgids control comes from thorough wetting of twigs where they reside. It is not practical to spray forest grown trees from trucks or airplanes. The high volume of sprays needed to soak infested twigs makes it impractical to haul sprays to hemlocks that are not along roadways and aircraft do not have the carrying capacity to spray a 100 or more gallons of sprays per acre.

Declining forest trees can be salvaged. Landowners should annually examine hemlock stands for symptoms of decline or signs of hemlock woolly adelgids. Salvage cuts will not slow the spread or buildup in density of the adelgid, but reduce economic losses.

Hemlocks declined within sight of highways in New York. Declines occurred between Newburgh and Plattsburgh along the New York State Thruway and the Adirondack Northway and Albany and Binghamton along Interstate Highway 88. Salt injury caused needles to turn brick red or brown by early spring. Foliage facing the road, nearest the road and downwind are most severely damaged. New growth masks damaged needles by early to mid summer. Mortality of young hemlock from salt damage occurred 40 miles west of Albany along the New York State Thruway.

Salt is used for deicing. The roads last winter were icy and large quantities of deicing salts were applied. Vehicles pulverize salt and create air turbulence that carries salt sprays to hemlock foliage. The problem reoccurs annually, but varies depending upon weather conditions.

Hemlock decline from the effects of drought of 1988 was highly visible along the same highways as described above. Declining hemlocks had dead tops. More advanced symptoms of decline included needle browning and tree mortality. Tree declines were confined to hemlocks on shallow, droughty soils. Hemlocks on deep, moist soils showed no symptoms of drought injury.

Hemlock declines from overcrowding and overmaturity occurred in the Kingston area. Small and large trees died or in the case of old trees, their tops dieback. Mortality of small hemlocks was due to competition for light, water and nutrients with larger trees. Large tree dieback was due to overmaturity and rots. One evidence of

overmaturity is top dieback. Overmature trees die from the tops downward. Breakage is due to rots which weaken the branches and trunks. Rots develop more in slow growing trees. This is because wounds of slow growing trees heal slowly. Slow healing gives wood decay organisms more time to develop.

Other pests of eastern hemlock are spider mites, florinia scale and hemlock scale. Mites and scales attack the needles of hemlock. Severe mite damage produces a yellow band along the needle base. Webbing is also present. Usually the damage becomes conspicuous after the mites have gone. Scale insects occur on the undersides of hemlock needles. Heavy scale infestations turn the undersides of hemlock needles a whitish color. Severe, long-term mite and scale infestations can cause yellowing of needles and slow growth. Hemlock borer attacks of weakened hemlocks from mites and scales has not been observed. Spider mites and needle scales are at epidemic levels throughout southeastern New York. Mites and scales compete with the adelgids for food and space. It is not known if mites and scales make hemlock more vulnerable to hemlock woolly adelgid attacks.

Forest health reports

Department forestry staff are reporting three times annually on the state of forest health in their respective counties. Annual compilations of forest health data make assessments of forest health changes possible.

Gypsy moth larval disease

A high death rate of gypsy moth larvae occurred due to a fungus disease, Entomophaga maimaiga (no common name). It was introduced to the United States in 1911 from Japan. We know of no record of the fungus in New York prior to 1989. Deceased larvae hung head down from tree trunks. In contrast, virus killed larvae have a "V" shape. The virus has historically been responsible for gypsy moth larvae population collapses in the second or third year of an epidemic.

The fungus occurs on Long Island, Westchester, Putnam, Dutchess, Rensselaer, Washington, Essex, Warren, Albany, Ulster, Orange and Sullivan Counties. It was not found in Cattaraugus, Tompkins, Jefferson or Clinton Counties. The fungus reduced host tree defoliation and gypsy moth egg laying, but foliage damage and post defoliation egg mass densities were high in some locations with the fungal disease.

The prolonged wet spring and summer favored the development and spread of the fungal disease. Elsewhere in the United States prior to 1989, the disease has not been mentioned as a cause of mortality of gypsy moths. But in 1989, other states in the northeast report mortality of gypsy moth

Larch declines

Eastern larch beetles kill tamarack. Older tamaracks declined more than younger ones. Pine wood nematodes have been observed in declining tamarack. Their role in the declines is unknown. Longhorned beetles, bark beetles and other secondary insects infest tamarack that is infected with nematodes. Beetles inoculate tamarack with wood-staining fungi. Tamarack decline was first documented in the early 1920's in New York and most mature tamarack died in the Adirondacks soon after. Declines followed defoliation by the larch sawfly, an introduced insect, and larch beetles. Many tamarack have grown to mature size since the 1920's and the decline cycle is being repeated, but without the precursor defoliation in some stands.

Merchantable larch stands should be inspected annually to detect crown discoloration and the presence of bark beetles. If evidence of crown dieback and buildup of beetle populations are observed, tamaracks should be harvested promptly to salvage wood.

Larch casebearer damage was widespread in 1989. It damaged European, Japanese, Dunkeld and native larches in Cortland, Chenango, St. Lawrence, Clinton, Franklin, Lewis and Jefferson Counties, which are the only counties detection surveys were done and reported on.

The casebearer overwinters in the larval stage in hollow needles attached to host plant twigs. In the spring, the larva emerges from its resting place and mines new needles. By June 12th, miner activities had ceased in Cortland and Chenango Counties. Larvae by that date had pupated and hordes of tiny, silvery adults were observed whenever larches were shook. Egg laying takes place soon after adult emergence and eggs are laid singly on larch needles. Eggs hatch within two weeks and newly hatched larvae mine needles until fall. Late season mining do not damage trees.

Larch needles mined in May were greener by June 12th. Larch needles grow from the base and the larch casebearer mines the needle from the tip inward. The greening of needles occurred due to normal elongation after the miner completed its feeding.

Larch growing in wet areas was compared to larches growing on dry sites. On wet sites, the needle length was much shorter than that of dry site larch. Additionally, shoot elongation of wet site larch was often only one fifth the

length of dry site larch. Wet site larch had less foliage for larch casebearers to feed on than dry site larches. Often wet site larches have a higher percentage of their needles mined than dry site larches. Furthermore, dry site larches mask the foliage damage better than wet site larches by producing longer needles and shoots.

Spruce\fir declines

Studies to determine why spruce and fir decline began in 1984 by the US Forest Service. All the data on spruce and fir declines has been gathered, but not completely assessed. A final report on the study is due in 1990. The studies enable us to describe the decline symptoms and important causal agents.

Data for Tug Hill and the Adirondacks was kept separate to compare results for the two regions. The spruce on the Tug Hill had much poorer regeneration than those in the Adirondacks, Vermont, New Hampshire, Massachusetts or West Virginia where the spruce/fir study was conducted. The reason for the poor regeneration is unknown. Declining spruce stands are replaced with deciduous trees. The decline of spruce may be normal plant succession from spruce to northern hardwoods, but the process is poorly understood.

Needle retention of spruce and fir is good. Where defoliation occurred, it was attributed to the dieback of branches due to breakage from snow, ice and wind. The dieback of branches was not attributed to the loss of needles. There was little needle chewing, mining, galling or twisting. Crowns of spruce and fir did not thin during the study.

Needle discoloration was widespread and unexplained. Needles had flecking, mottling and banding. The outer half of many needles were brown or yellow. Mottling occurred on the upper and lower surfaces of needles throughout the crown. Flecking was the most common discoloration found on fir. Fir needles were less discolored than spruce. The significance of needle discoloration, which affected most spruce and fir, but not all needles, is unknown. Discoloration increased during the study period. Discoloration of needles or changes in discoloration intensity may not signify unhealthy trees or it may indicate air pollution or other stresses.

Brooming occurred on 50 percent of the spruce. Spruce brooms were caused by the parasitic eastern dwarf mistletoe. Mistletoe will eventually kill infected spruce. Before the study, mistletoe had last been recorded in the state in 1936. It is a killer of old growth spruce.

Brooming occurred on 25 percent of the fir. Brooms are caused by fir broom rust, a fungal disease. Broom rust is also known as yellow witches'-broom. Broomed shoots are upright and dwarfed with short yellow needles that drop in the fall leaving denuded shoots. Severe infections reduce growth, cause branch and trunk swellings and kill trees.

Resinous was common in spruce and fir. Resins flowed from wounds caused by spruce beetles and branch stubs. The slow growth of spruce and fir due to competition and overmaturity results in slow healing. Wounds are invaded by wood rots. The must significant one is red heart rot (Phellinus pini). Rots increase breakage.

Eastern spruce beetles are at epidemic levels in the Adirondacks. Spruce beetles attack large diameter spruce and kill them by girdling the tree. Small diameter spruce are not killed by the spruce beetle. Study plots in the Adirondacks were on Forest Preserve lands where spruce is not cut. The no cutting policy for 100 years has resulted in large diameter spruce and increased the infestations of spruce beetles. Spruce beetles will not cause the extirpation of spruce. Young spruce are replacing dead and dying spruce.

Ghost moth larvae kill young spruce at high elevations. Large numbers of ghost moth larvae occur above 3,000 feet elevation on White Face Mountain. Examination of dead spruce regeneration reveals severe root damage by the ghost moth larvae. Ghost moth larvae are responsible for some spruce regeneration failure at high elevations. Studies by the University of Vermont scientist should clarify the role of ghost moths in spruce survival.

Fir wave is long term and widespread. Prolonged and frequent high winds cause balsam fir on high elevations to sway. The swaying breaks roots and eventually the root damage leads to the death of the fir. Dead firs drop their needles and winds, less impeded by the loss of needles, penetrate deeper into the fir stands. Wave after wave of fir die in this manner. Loss of needles admits sunlight to the forest floor. Prolific spruce and fir seedlings grow underneath the dead and dying fir. Bands of reproduction and dead trees give the mountain sides the appearance of wave patterns. Fir wave is a natural phenonomenun and not related to air pollution.

Sugar bush study

Maple syrup producers are concerned that sugar maples are declining. DEC surveyed 16 counties and 31 sugar bushes in northeastern New York to determine their health. Bushes were rated as excellent, good, fair or poor based on their crown condition. A total of 4 bushes were rated

excellent. These bushes had no visual crown damage. 17 bushes were rated good. Good bushes have minor crown damage on few trees. 10 bushes were rated as fair. Fair bushes have moderate crown damage on many trees. No bushes were rated poor. Poor bushes would have severe crown damage and dieback on many trees. Bushes in this study were randomly selected and believed to be representative of nearby bushes.

Excellent and good bushes are productive. They have no significant natural or human disturbances. Maples had room to grow and well developed crowns. Tap hole closure was good because radial growth rates were good. There was no recent history of defoliation. Cattle were not grazed in the bushes. Bush soil was not excessively wet or dry. There was little mechanical wounding of roots or bark from equipment used in the management of the bush. Tapping was not excessive. Fair bushes did not share the above qualities with excellent and good bushes.

Soil samples have been taken from each bush but analysis of nutrient levels and acidity is not completed. Plots will be reread within five to six years to determine if the bushes have grown more or less healthy and to ascertain why these changes have occurred.

Sugar Maple Decline Study

An international project established in four Canadian provinces and seven states, including New York is to determine if and where decline of sugar maple occurs. The project began in 1988 and will end in 1990 with a report comparing the crown conditions of sugar maples in polluted air and clean air forests and managed and unmanaged forests.

Urban tree inventory

DEC forestry staff conducted a surveys of tree stocking and health at Ocean Beach, Fire Island and 18 other cities in New York State. The survey is part of a national effort sponsored by the American Forestry Association to determine the potential for increased planting of trees in urban areas. Our survey revealed that Ocean Beach, unlike most American cities, is well treed with healthy, diverse species. An earlier, more limited survey in scope, completed by the American Forestry Association, revealed that only one tree is planted for every four trees that are cut or die in American cities. Trees cool city streets and remove carbon dioxide from the air. The cooling effect comes from evaporation of water from the tree's leaves. Carbon dioxide removal from the air and storage in the form of carbon compounds in trees is desirable. Carbon dioxide in the air is linked with the greenhouse effect and the gradual warming of the earth.

PLANT CONSERVATION

Environmental Conservation Law authorizes DEC to develop conservation programs to protect plants. The Division of Lands and Forests is lead agency in DEC for plant programs. We view herbaceous plants and shrubs as an inseparable part of the forest. Understory plants are indicators of forest health. Changes in relative abundance or symptoms of decline in these plants can indicate forest health problems. Our goal is to maintain a natural diversity of healthy plants. To do so, we have several programs to protect plants.

American ginseng

American ginseng is a native plant extensively collected in the wild for its valuable roots. It has disappeared from 10 counties of New York and it is threatened with extirpation elsewhere in the state. The Convention in Trade in Endangered and Threatened Species lists American ginseng as endangered. For this reason, the US Fish and Wildlife Service, which is the federal agency to administer CITES for the United States, has banned ginseng export to foreign counties unless the state has an approved conservation program. To protect this plant, DEC adopted a regulation that establishes a ginseng harvest season, dealer permitting, certification of ginseng for export and conservation practices. Ginseng is also a Protected Native Plant under the New York Codes, Rules and Regulations, which makes it a violation of Environmental Conservation Law to collect ginseng without the landowner's permission, punishable by a $25 fine per plant. We do not authorize the collection of ginseng from DEC administered state lands without obtaining a Temporary Revocable Permits. Permits are issued only for educational or scientific purposes.

The US Fish and Wildlife Service approved DEC's ginseng program for 1989. Approval makes it legal for New York grown ginseng to be exported to foreign countries. In 1988, wild ginseng sold for about $250 per pound and cultivated ginseng sold for about $60 per pound. The total value of New York grown ginseng reported to DEC in 1988 is about $350,000.

Protected Native Plants

Until June 22, 1989, there existed only one list of official protected native plants. This list was part of a DEC regulation known as Protected Native Plants. The list was unsatisfactory for environmental planning purposes because it did not distinguish between rare and common plants. Additionally, there were no criteria in the regulation governing the listing or dropping of plants. Still another deficiency was the lack of standard names. A new Protected

Native Plants regulation was adopted, which established four lists of plants and criteria for their listing. Rare plants were listed as endangered, threatened or rare. Plants commonly illegally collected are listed as exploitable vulnerable. Listed plant names are consistent with those found in the A Checklist of New York State Plants. The scientific name of plants governs determinations on violations under this regulation. Federal listing of a plant as endangered or threatened in New York results in its protection under this regulation. This provision of the regulation was not part of the former Protected Native Plants regulation.

Rare plants influence land use decisions

Rare plants are an important consideration in purchase of unique areas and forests of exceptional character under the 1986 Environmental Quality Bond Act. The existence of endangered and threatened species will raise wetland classifications. The presence of endangered and threatened species will also affect unit management plans being developed for State Forests and Forest Preserve lands. Unit management plans include provisions for rare plant preservation and recovery.

US Fish and Wildlife Funded Plant Studies

DEC is the lead agency for receiving US Fish and Wildlife Section 6 funds. Eligibility for funding is contingent on a Limited Authorities Agreement between DEC and US Fish and Wildlife Service. Funds have been received for the past five years to study federally listed endangered and threatened plants. Currently northern monkshood, small whorled pogonia and sand plain gerardia are studied.

Small whorled pogonia is extirpated in New York. The closest population of this species to New York occurs within a few feet of the state's border in the State of New Jersey. The last confirmed record of this species was in early 1980's in Chenango County. Studies of northern monkshood lead to a discovery of several populations in three counties. The population is double what was known before the study began. DEC protects this species through land management by prohibiting trails within 50 feet of waterways. Trail walkers and campers have destroyed many northern monkshoods by trampling and compacting soil.

Development threatens some populations of sandplain gerardia on Long Island, the only place in New York were this species grows. Work is in progress to identify the exact locations of sandplain gerardia in reference to proposed development.

Harts-tongue fern is proposed for federal listing in New York. This fern occurs in only three locations and the total number of plants are few. Funding has been requested by DEC of US Fish and Wildlife Service to study this species.

FUTURE FOREST HEALTH PROBLEMS

It is possible to predict forest health to the mid 21st century by projecting trends in place throughout the 20th century or longer.

Aging

The forests of New York are growing old. Growth exceeds cut by a factor of two. Forest health studies reveal many kinds of problems with the aging of trees. Forest health will decline as trees grow old. Many forest acreages are not cut or only partially cut because they are in Forest Preserves, park lands or environmentally sensitive areas.

The risk of mortality from pests and weather increases with age. Aging results in succession of trees from shade intolerant to shade tolerate trees. We can conclude from this knowledge that the incidence of mortality from pests and weather will increase in the next century. We can also conclude that our forests will have a greater component of shade-tolerant trees. These changes will affect the appearance of the forests, for climatic species of trees produce more shade than do those in pioneer and intermediate stage forests. One change will be a reduction in the relative abundance of herbs, shrubs and vines. Impacts on the wildlife are not addressed in this report.

Pestilence

Many potentially destructive insects and diseases exist in foreign countries. Presently, introduced pests are the most significant cause of forest declines in New York. Several new species of pests arrive each decade. Not all of them become major factors in forest declines. However, once they become established, they rarely die out. Their damage is added to the damage caused by other introduced and native pests. The accumulative effects of these pests will increase because there will be more kinds of pests and they will have had more time to become established and spread throughout the state. Some examples of introduced pests are: chestnut blight, which completed its spread in 1930's; Dutch elm disease in the 1960's; gypsy moth in the 1970's; and pear thrips in the 1980's. Other introduced pests spreading or intensifying are hemlock woolly adelgid, red pine scale and red pine adelgid in southeastern New York.

There are numerous other introduced pests that could be cited.

Other introduced pests are threatening and their long-term potential impacts cannot be assessed. Included are larch canker which occurs along the coast of Maine, helicoid bagworm, which first appear near the Port of Albany in the 1970's and has spread along the Erie Canal and in the Capital District region, and large tar spot disease of Norway maple, which dramatically spread in 1989.

Management Limitations

The forests by the end of the 21st century will look different than they do now. More than eight million acres of agricultural lands have grown up to forests in the past 120 years. These forests by the end of the 21st century will have evolved from pioneer to climatic species. There will be relative fewer trembling aspen, white ash, black cherry, black birch, red and white oaks. There will be more American beech (at least beech thickets), eastern hemlock (if the hemlock woolly adelgid does not destroy them), red and sugar maples. Forest managers could change natural plant succession by clear cutting. But public sentiment is against clear cutting and most forests are selectively logged or not harvested. As a result, shade resistant trees are replacing shade intolerant trees.

Many exotic tree species are widely planted in New York. Increasingly, these species are being killed by native pests or declining because they are not adaptive to our climate. An example is destruction of Japanese black pine by pine woods nematode and black turpentine beetle. Another example is the decline of Norway maple through injury by frost and infection by cytospora canker. As exotic trees age, we will see increasing damage from pests and the weather.

Fire is required for certain types of forests to regenerate. Because people have built homes in forests that once burned periodically, wild fire is no longer permitted. The effect of wild fire prohibitions is that pine barrens on Long Island and Albany will become smaller as competing vegetation that is not fire tolerant, takes over from fire tolerant species. Fire once reduced needle cast disease and leaf miners of oak, that currently are at epidemic proportions.

Loss of biological diversity

Among the declining tree species are American chestnut, American beech and American elm. Eastern hemlock may become less common because of the hemlock woolly adelgid. Of the shrubs, flowering dogwood has declined because of a fungal disease. Many herbaceous plants have declined from

drainage of wet lands, land clearing and development. Over the next several years, data on biological diversity should reveal the rate of diversity decline. Forbes, too, have become less common. An example is American ginseng.

CONCLUSIONS

Forest health is one of the most important environmental issues facing us today. Forests cover 62 percent of the land area of the State. Forests have desirable effects on global weather, including the removal of carbon dioxide, which traps heat and many scientist believe responsible for the long-term global warming trends. Forests filter the air we breathe, improve water quality, provide employment to thousands of people in the wood-using businesses and offer recreational opportunities for millions more. Forests are the homes of wildlife and many rare and endangered plant species are dependent on healthy forests.

Introduced tree pests are the primary known causes of declines. Continued spread and buildup of introduced pests will result in further forest declines and may prevent some species of trees from recovering such as American chestnut. Air pollution may be increasing tree susceptibility or vulnerability to insects and diseases.

A substantial effort is being made to better understand the causes of tree declines and in particular, the role of air pollution. In addition to these studies, there is a growing need to reverse damages that have already occurred to forests. We need to find ways for forests to recover from such diseases as chestnut blight, beech bark disease, and ash yellows. Understory plants, including shrubs, vines and herbs will increasingly become important as indicators of forest health. A healthy forest will increasingly be described as a forest where biological diversity is maintained. Forest managers will increasingly be judged by their ability to maintain biological diversity and to restore species that have declined or have been extirpated.

We have many reasons to expect our forests will recover and continue to prosper. There is a growing public recognition that forest health is vital for a good environment. With this recognition has come increased efforts to learn about the causes of forest declines and take remedial actions to protect the forests.

APPENDICES

REGIONAL REPORTS

The following information is arranged by three regions outlined on the map at the end of this report.

We have listed and discussed the major tree problems in each region. The forests statewide and regionally are healthy. However, problems are present, some quite visible, of which the reader may or should be aware.

APPENDIX A
CAPITAL DISTRICT AND CATSKILL-LOWER HUDSON REGION

Autumn Olive

A fungus disease to twigs and branches occurs on Fire Island. Cankers are characterized by split, orange bark. Mortality of branches occurs beyond cankers. Dieback of Autumn Olive is variable from plant to plant. Some plants have died back to the ground. Other plants have twig or small branch dieback. Many plants have no symptoms of dieback. The causal agent is unknown.

Basswood

Westbury Gardens in Nassau County grows prized American basswood. For several years, the Garden staff have combated the basswood leaf miner. Other hosts of this insect, which were identified in 1827, include oak and apple. But basswood is the primary host. Adult beetles overwinter in litter beneath host trees. In the spring they emerge and skeletonize leaves. By June 15th, the beetles have mated and eggs are laid singly along the edges of the skeletonized leaves. They cover the eggs with their feces to conceal them form predators and parasites. 37 to 43 eggs are laid by each female.

Eggs hatch in 10 days. Larvae mine leaves for four or five weeks. Sometimes three larvae are found in a single mine. Each larvae mines a square inch of leaf. Pupation occurs in the mined leaves.

This insects damages basswood by it feeding. Feeding damage results in slower growth of the tree, twig mortality, cosmetic problems, and significant expense incurred in monitoring the insect, destroying infested litter beneath host trees and spraying pesticides to suppress beetle numbers.

If one sprays the foliage too early, the spray residue will be gone when most of the beetles appear. If sprays are too late, the beetles will have laid their eggs and the pesticides have no effect on the eggs. Spraying at the Gardens was correctly done, for the only parts of the trees severely damaged were the upper crowns, which were too tall to spray. Unsprayed trees were severely damaged by the beetle.

Black Locust

Black locust tolerates salt. It grows naturally along Long Island Sound within a couple hundred feet of the shoreline.

Locust leaf damage was detected and conspicuous. Irregular, blister like mines associated with the midrib of the leaf are caused by the "locust leaf mining moth", a name coined for Parectopa robiniella. At Sound Beach, 15 to 20 percent of the leaf surface was mined by this insect.

A plant bug with a brightly colored orange stripe was observed feeding where leaf flecking occurred. The flecking was severe enough to change the appearance of the locust leaves from a distance of a hundred feet.

Dogwoods

Dogwood anthracnose causes leaf spots, stem cankers and kills shoots. Eventually the whole plant is killed. The disease occurs in southeastern New York. Initial symptoms are large purple-bordered leaf spots and scorched tan blotches that can enlarge and kill the leaf. Another useful symptom in detecting the disease is the brown blighted leaves that hang on the plant after normal leaf fall. Trunk sprouts occur during the late stage of the disease. Cankers occur on the main stem. To detect cankers, which are useful for assessing the stage in the disease and prospects for plant survival, peel the bark away from a small section of stem. Cankers produce distinct margins from the healthy light green tissue beneath the bark.

There are many kinds of problems with dogwoods. Dogwood anthracnose is the most serious problem and it is difficult to control. Throughout southeastern New York this disease has devastated dogwoods.

Juneberry

Lacebugs, with their intricately laced wings and sculptured bodies caused conspicuous flecking of Juneberry leaves. Flecking results from feeding wounds that lead to dead tissue at the feeding site and from the lacquer-like spots, which is lacebug excrement.

Lacebugs are abundant and gregarious. Most of the damage they caused was concentrated near the midrib and toward the petiole end of the leaf. Damage is too light to kill Juneberry.

Larch

Resinous was detected in a larch plantation in Sullivan County. Only a few larches produced resin on their trunks at mid crown. Deep, longitudinal tunneling under the bark by the balsam fir bark beetle caused the resin flow. The

beetle populations had developed in larch slash from a recent thinning. The pitching is the response of the larch to beetle attacks. Infested larches have large quantities of pitch flowing down their truck, beetle emergence holes in the bark, and yellow needles. When bark beetles become destructive in conifer stands, it is prudent to identify trees under attack and promptly remove them to reduce beetle breeding habitats.

Maples

Saddled prominent occurred at epidemic levels in eastern Delaware County. It defoliated sugar maples, American beech and black cherry. A total of 130,000 acres were stripped of their foliage. This is the most severe outbreak of this insect in New York since the early 1970's. At that period, hundreds of acres of forests declined following two or three consecutive years of defoliation. This year's outbreak is the first. No significant tree mortality is expected. Trees received abundant rainfall in 1989 and they had vigorous crowns before the defoliation.

Few saddled prominent larvae survived. No pre-pupae or pupae could be found. Pupation occurs in the soil beneath host trees. The cause of larval mortality was a fungal disease close in appearance to the one killing gypsy moths. The larval disease occurred late in the feeding season and so, there was significant levels of foliage damage before the larvae were killed.

Oaks

Oak leaf miners are at epidemic levels on Long Island. The two species damaging trees are the gregarious and solitary oak leaf miners. Mined foliage turns brown. Branch mortality occurs in heavily damaged trees. Parasitism of oak leaf miners is too low to prevent a recurrence of the insect in 1990. However, many dead miners were observed in the leaf mines. They had died from starvation.

Also conspicuous, but not harmful, is the oak apple galls on black oak twigs and leaves. Within the papery gall, the size of a golf ball, lives a single, sparsely haired larvae among a fibrous mass. This gall should not be confused with the destructive oak horned gall, which abounds on oaks in some locations of Nassau County. This latter gall girdles oak tree branches. Severe girdling leads to dead major branches and in some cases tree mortality.

Pines

Japanese black pines throughout Long Island are dying from the effects of the pine wood nematode and black turpentine beetle. The tree is widely planted for its natural beauty and salt resistance. It grows rapidly on excessively well drained, droughty and nutrient-deficient soils.

Nematodes kill Japanese black pines within one or two growing seasons. Foliage of nematode infested trees turns yellow and then brown. Numerous holes caused by wood-boring beetles, including round and flat headed borers, occur in the nematode-infested trees. Wood infested by beetles is stained. The turpentine beetle produces pitch masses at the base of the pine. Galleries created by its larvae are of large diameter and girdle the pine.

Burn or bury infested trees to reduce the breeding habitats of the beetles vectoring the nematodes. Alternative species of trees will be substituted by the Saratoga State Tree Nursery for Japanese black pine, which is no longer sold by that nursery.

Pitch pine are dwarfed, have crooked branches, multiple stems and discolored foliage because of the Nantucket tip moth (introduced) and Eastern pine shoot borer. Repeated attacks change the size and shape of trees. Damage from tip moths is more severe on sites deficient in nutrients and humus. Other organisms causing abnormal coloration of foliage and appearance are: pine needle scales, pitch mass borers, needle miners, needle feeders, needle tiers and ploioderna needle cast. The pine needle scale was severely parasitized as evidenced by the numerous emergence holes in the scales. Fall browning when accompanied by abnormally dry and calm weather allowed the dead, three-year-old needles to cling to the tree, rather than drop off as they normally do. Declining, over-story, pitch pines are replaced with laurel, other pitch pines and oaks.

Pitch pine will not die from the above damage. The problem is more important for cosmetic reasons and as an indicator that soil fertility is low.

Red pine is declining rapidly in Dutchess County. In Westchester and Putnam Counties, most of the red pine is dead. Causes of the mortality are red pine scale and red pine adelgid. Both insects were introduced to New York. Red pine dies within five years of infestation. The scale occurs as far north as the Town of Northeast, Dutchess County. The most northern scale infestation in northwestern Dutchess County occurs near the junction of the Taconic State Parkway and Bulls Head Road. This infestation was found in the fall of 1987. The adelgid is found as far north as the Town of LaGrange, Dutchess County. The scale may be reaching its northern limits in New York. The

adelgid, however, is capable of living farther north than the scale. Average annual movement of scales and adelgids is two miles. The planting of red pine south of Columbia County border is not recommended.

Red pine scale was rediscovered west of the Hudson River in 1987. Last seen in the Sloatsburg area in the early 1970's in both Rockland and Orange Counties, no further evidence of the insect was detected. An infestation of red pine scale occurs one-quarter mile north of the Harriman Exit on the New York State Thruway in the Town of Woodbury. There is no practical control of scales on pines in the forest. Evidence of scales and adelgids are yellow or brick red needles, branch mortality, thinning crowns and mortality. In October, the white male cocoons are conspicuous on the undersides of branches.

Red pine plantations on State forests in Schoharie County are declining from the effects of the drought of 1988. Soils of declining stand are thin. The drought was severe. Weakened trees are attacked by bark beetles which quicken mortality rates. Declining pines had straw-like and brown needles. Eastern white pine growing on the same site where unaffected indicating that it is more drought resistant than red pine.

Diplodia tip blight kills new growth of Austrian pine. A symptom of the disease is needles stuck in resin. Damage by the fungus spoils the appearance of the tree. Austrian pine is no longer favored in this region for ornamental and shade tree plantings because of the disfigurement and blight caused by the fungus. Many Austrian pines along the Long Island State Parkways are dead from this disease.

Red Cedar

Red cedar is healthy on Long Island. It will be more widely planted to replace Japanese black pine. Red cedar appears salt resistant. It grows along ocean shorelines. It regenerates naturally on the Island. The difficulty in using red cedar as an ornamental and for soil erosion is that its seeds are not readily available for nursery use.

Snow injury

In October of 1987, before the deciduous trees dropped their leaves, a heavy, wet snow fell in large amounts throughout an extensive are of the eastern part of the region. The weight of the snow caused tree branches to break or whole trees to topple. In its aftermath, numerous deciduous trees have severe wounds. Wounds will be invaded by decay organisms and trees will rot from within and break in future storms. It takes upwards of 20 years for rots to weaken trees to the breaking point.

Appendix B
EASTERN,WESTERN AND NORTHERN
ADIRONDACK REGIONS

Maples

Forest tent caterpillars defoliated several thousand acres in Jefferson County. It is the most destructive native defoliator. It is also responsible for killing maples on 200,000 acres of southern Delaware and western Sullivan Counties in the early 1980's. High mortality of maples followed a single complete defoliation.

Parasitism of larvae and pupae were high. 85 percent of the pupae had fly maggots in them. Additionally, many larvae died from the disease.

White pine in the Adirondack regions are heavily infected with white pine blister rust. This disease requires an alternate host such as currants or gooseberries to complete part of its life cycle before returning to the pine and killing it.

The European strain of scleroderris canker is still present in the region, but is not as destructive as in the past. Wet, cool weather could lead to an increase in infections and mortality of hard pines from scleroderris canker disease. In the 1970's, the European strain of the disease killed up to 90 percent of red and Scotch pine stands that were 30 to 40 years old. Since 1981, the disease has not spread, nor is it killing older trees.

Yellow birch decline

Mature and over mature yellow birch are declining more than younger birches. Declines are more severe where forests have been disturbed by logging, mortality from beech bark disease, or red spruce decline, since birches are very sensitive to changes in soil temperatures. The declines are widespread and could be incited by air pollution damage or a warming trend.

Birch decline was first reported in 1932 in New Brunswick, Canada. Paper and yellow birches died over a 13-year period. Birch reproduction was poor. Declines increased again in the early 1950's and have been reported periodically since then.

Birches, more so than other species of hardwoods, do not tolerate changes in site conditions. Following logging, residual birches frequently decline. Causes of the declines appear to be bronze birch borer that girdle and kill trees, apple mosaic, which produces virus-like symptoms and

increased soil temperatures from increased exposure of roots to sunlight, and a possibly a regionwide warming trend. The primary, inciting agent of birch decline is unknown.

APPENDIX C
LAKE PLAIN, SOUTHWEST, AND SOUTH-CENTRAL HIGHLANDS

Maples

Drought of 1988 caused browning of leaf margins of sugar maples in Chenango County in the fall of 1988. Significant and extensive maple damage did not occur from the drought.

Defoliation by fall cankerworm damaged maple. Some maple stands have died following a single complete defoliation. In one forested area in Cattaraugus County, maples died after defoliation in the early 1970's. Heavy browsing by white-tailed deer has prevented regeneration of trees.

Oaks

Oak decline occurred in Cattaraugus County near Killbuck and the Allegany State Park in the 1960's. The cause of this decline was not determined and oak wilt was not found. Since 1980, following heavy defoliation by gypsy moths, oak decline has become widespread in Steuben, Allegany, Yates, Chemung and Cattaraugus Counties. The two-lined chestnut borer and root rot disease invade and kill oaks weakened by defoliation. Oak wilt has never been found in New York.

Norway Spruce

Separation of annual rings observed in Norway spruce in this region may related to droughty conditions. The separation would occur under extreme dry conditions causing the wood to shrink and separate. The condition is termed shake. Shake reduces the value of wood for lumber.

INDEX BY HOST

ashes 7, 24-25

aspens 24

beech 6, 13, 24-25, 28, 31

birches 3, 6, 24, 31-32

cedar 30

cherry 24, 28

chestnuts 5-6, 11, 23-25

currants 31

dogwoods 24, 27

elms 7-8, 24

firs 3, 13, 18-19

ginseng 14, 21, 25

gooseberries 31

hemlock 14-16, 24

larches 17-18, 27-28

locust 27

maples 9-10, 19-20, 24, 32

monkshood 22

oaks 10-11, 24, 26, 28

pines 3, 5, 11-13, 24, 29-31

pogonia 22

Protected Native Plants 21

spruces 3-4, 18-19, 32

INDEX BY CAUSAL AGENT

acid rain 5,9
adelgids 13-16, 23-24, 29-30
air pollution 3-4, 13, 18-19, 25, 31
anthracnose 13, 27
bagworms 24
beetles 6, 8, 12, 17, 19, 24, 26, 27-29
blights 5-6, 23, 25, 30
borers 9-10, 14, 16, 29, 31-32
cankers 13, 24, 31
decays 6, 16, 30
declines 3-7, 9-15, 17-18, 20-21, 23-25, 31-32
diseases 5-11, 13, 16, 19, 23-25, 28, 31-32
drought 6, 10, 15, 30, 32
fir wave 19
frost 9, 24
fungi 6-7, 12, 17
galls 28
insects 4
land clearing 24
maturity 9
miners 17, 26
mistletoes 18
mites 16
moths 10-11, 16, 19, 28-29, 32
nectria 6
nematode 24, 29
rots 4, 10, 12, 15-16, 19, 30
salt 10, 15, 27, 29-30
sapstreak 9
scales 6, 16, 23, 29, 30
snow injury 30
thrips 9-10 13-14, 23
weevils 12
winds 3-4, 14, 18
wilts 32
yellows diseases 7-8, 25

Regional Forestry Offices

Region 1 -- Stony Brook
Building 40, SUNY
Stony Brook, NY 11790
(516) 751-7900
(Nassau, Suffolk)

Region 2 -- New York
1 Hunters Point Plaza
Long Island City, NY 11101
(718) 482-4942
(New York City)

Region 3 -- Wappingers Falls
Stony Kill Environmental Education Center
Rte. 9D
Wappingers Falls, NY 12590
(914) 831-3109
(Dutchess, Westchester, Putnam)

Region 3 -- New Paltz
21 South Putt Corners Road
New Paltz, NY 12561
(914) 255-5453
(Orange, Rockland, Sullivan, Ulster)

Region 4 -- Stamford
Jefferson Road
Stamford, NY 12167
(607) 652-7364
(Delaware, Montgomery, Otsego, Schoharie)

Region 4 -- Catskill
P.O. Box 430
439 Main Street
Catskill, NY 12414
(518) 943-4030
(Albany, Columbia, Greene, Rensselaer, Schenectady)

Region 5 -- Ray Brook
Ray Brook, NY 12977
(518) 891-1370
(Franklin, Clinton, Essex)

Region 5 -- Northville
Northville, NY 12134
(518) 863-4545
(Fulton, Hamilton)

Region 5 -- Warrensburg
P.O. Box 220
Warrensburg, NY 12885
(518) 623-3671
(Saratoga, Warren, Washington)

Region 6 -- Lowville
RD#3, Box 22-A
Lowville, NY 13367
(315) 376-3521
(Jefferson, Lewis)

Region 6 -- Canton
30 Court Street
Canton, NY 13617
(315) 386-4546
(St. Lawrence)

Region 6 -- Herkimer
225 North Main Street
P.O. Box 89
Herkimer, NY 13350
(315) 866-6330
(Herkimer, Oneida)

Region 7 -- Cortland
Box 5170
Cortland, NY 13045
(607) 753-3095
(Cayuga, Cortland, Onondaga, Oswego, Tioga, Tompkins)

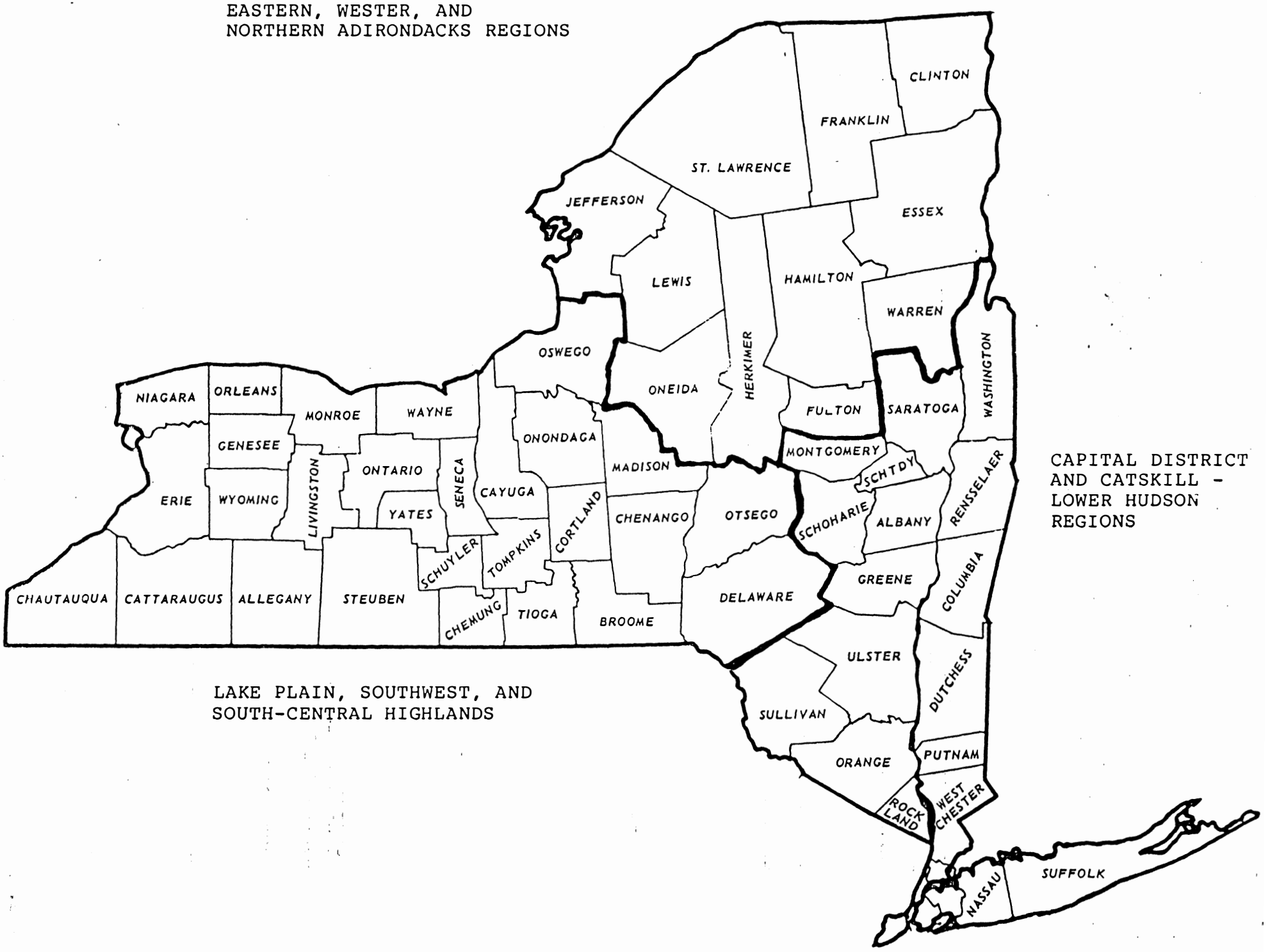
Region 7 -- Sherburne
Box 594, Rte. 80
Sherburne, NY 13460
(607) 674-4036
(Broome, Chenango, Madison)

Region 8 -- Bath
P.O. Box 351, 115 Liberty Street
Bath, NY 14810
(607) 776-2165
(Chemung, Genesee, Livingston, Monroe, Ontario, Orleans, Schuyler, Seneca, Steuben, Wayne, Yates)

Region 9 -- Olean
128 South Street
Olean, NY 14760
(716) 372-0888
(Allegany, Cattaraugus, Erie, Chautauqua, Niagara Wyoming)

Region 9 -- Falconer
215 South Work Street
Falconer, NY 14733
(716) 665-6111
(Allegany, Cattaraugus, Erie, Chautauqua, Niagara Wyoming)

EASTERN, WESTER, AND
NORTHERN ADIRONDACKS REGIONS



LAKE PLAIN, SOUTHWEST, AND
SOUTH-CENTRAL HIGHLANDS

CAPITAL DISTRICT
AND CATSKILL -
LOWER HUDSON
REGIONS